

VII. Management, Cost and Schedule

The EDM collaboration will develop a management plan for the experiment as part of its preparations for a full technical review. This plan will be modeled after the one used by the $np \rightarrow d\gamma$ experiment at LANSCE but with appropriate modifications to suit the needs of the EDM project. In this chapter, we will summarize the elements of the plan and will include a description of the proposed management team. Additionally, we will present the costs and schedule as part of the work breakdown structure down to level 2. A breakdown to level 3 and a discussion of the methodology will be found in Appendix B. Finally, we will enumerate the tools we will use to control cost and schedule overruns.

A. Management Team

The management organization specifies responsibilities for getting the EDM experimental hardware designed, built, installed, and commissioned. Special attention will be given to the quality and integration of components of the experiment. The management team consists of the spokespersons, the project manager, the executive committee, and the work package leaders.

The spokespersons have overall responsibility for the design, construction, installation, and commissioning of the experiment and the beam line. They must control costs, keep the schedule and deliver performance. In their roles, the spokespersons report directly to the P-23 and P-25 Group Leaders and the LANL Nuclear Physics Program (NPP) manager. The spokespersons also have the responsibility of coordinating the work of the collaboration and responding to technical and scientific initiatives from the collaboration.

A project manager from LANL assists the spokespersons. The project manager is responsible for the project management of the construction project. He is responsible to provide information on the schedule and budget so that the spokespersons can deliver all necessary equipment on schedule and within the budget guidelines defined in this document. He shall establish the budgets and schedules for the construction of the experiment based on the information provided by the work package leaders. The project manager is responsible for tracking the progress of the project - cost and schedule - and reporting progress to the spokespersons, LANL management, and the DOE. He shall formulate the guidelines for making changes in the budget, the schedule or the performance, following the clear rules for the handling of contingency funds. He will give progress reports at meetings of the executive committee and at collaboration

meetings. Also, written EDM monthly status reports will be sent to the appropriate people.

The executive committee assists the spokespersons in the management of the project. The executive committee is composed of the spokespersons, the project manager, and four representatives of the collaboration representing the broad interests of the collaboration. Unresolved issues in the executive committee are reviewed by the collaboration. The collaboration meeting is the highest authority for decision making. The membership of the Executive Committee will be selected by the collaboration and may be changed in subsequent collaboration meetings. The elected members of the executive committee, with the exception of the spokespersons and project manager, will serve for a maximum two-year term. The executive committee has specific responsibilities regarding the approval of major change requests. The other functions of the committee will be to serve as the stewards of the experiment, consult regularly with each other and with the collaboration to facilitate communications, and to monitor the overall status of the project. The executive committee represents the collaboration in an advocacy role to funding agencies, LANSCE, Physics Divisions, and in other situations.

The work of constructing the EDM experiment is divided into work packages that are managed by work package leaders. A work package leader is responsible to lead and oversee the specifications, design, maintenance and operation of his/her work package. The allocation to carry out the work will be distributed by the spokespersons. The definition of all specifications and design parameters for the work packages will be given in the work package dictionary of the management plan. The work package leaders serve as information resources for the project manager by providing advice and additional information as needed. The work package leaders are responsible to report monthly on the status and progress of their work packages to the project manager.

B. Costs Summary

The full capital-cost of the EDM construction will be \$11.1M based on the rollup of Microsoft Project file from level 3. In addition, \$1.5M will have already been spent on equipment from LANL LDRD funds during the development period, FY'01-'03, and it is expected that \$0.3M will be spent in FY'04. The collaboration will seek additional funds from LANL LDRD and from other institutions, e.g. from agencies that normally fund the operating costs of the collaboration. Whereas these future funds are not guaranteed, they are not counted below.

The cost estimate includes 23.5% taxes (LANL capital equipment rate) at the participating institutions and 40% average contingency. By the time of a future conceptual design review (CDR), it should be possible to reduce the contingency. Approximately \$1M of contingency has been pushed into FY'07 because it is most likely to be needed at the end of the project. The profile has been prepared in FY'02 dollars. In accordance with DOE escalation-rate assumptions, the cost have been converted to “then-year” dollars to produce the table below.

Source	US FY'01-03 \$k	US FY'04 \$k	US FY'05 \$k	US FY'06 \$k	US FY'07 \$k
LDRD	1500	Possible	Possible	Possible	Possible
Collaborators			Possible	Possible	Possible
DOE NP			5400	3878	1805
Total	1500	310	5400	3878	1805

The following summary has been taken from the WBS displayed to level 2. These costs are only for the construction project and do not include the LANL funds for FY'01-'04. WBS item1 (development) and those with zero cost have been deleted. For more details, refer to Appendix B.

WBS	Task	Cost	Rolled-Up Cost
2	Neutron Beam Line		510,000
2.1	6-m Guide	130,000	
2.2	t0 Chopper	50,000	
2.4	Bi Filter	20,000	
2.5	Beam Splitter	300,000	
2.6	Spin Flippers	10,000	
3	Shielding		110,000
3.1	Beam Line (BL)	10,000	
3.2	Experiment	90,000	
3.3	Beam Stop	10,000	
4	Cryogenics		1,280,000
4.1	Gas Handling	50,000	
4.2	4He Purifier	200,000	
4.3	Cryostat and Radiation Shields	400,000	
4.5	Gases	80,000	
4.5	Auxilliary Volumes	100,000	
4.6	Support Equipment	150,000	
4.8	4He Recirculation System	300,000	
5	3He Atomic Beam Source		80,000
5.1	Transport Tubes	50,000	
5.2	Polarization Holding Coils	10,000	
5.3	Procure 3He	20,000	
6	Magnetic Shielding		415,000

6.1	5 Layer Conventional Shield	250,000	
6.2	Superconducting Shield	100,000	
6.3	Other Shielding	15,000	
6.4	Magnetic Penitrations	50,000	
7	Magnets		270,000
7.1	Constant Field Coil	200,000	
7.2	Power Supply	30,000	
7.3	Field Monitors	20,000	
7.4	3He Spin Flip Coils	20,000	
8	High Voltage		370,000
8.1	Gain Capacitor	100,000	
8.2	Electrodes and Corona Domes	150,000	
8.3	Penetrations	50,000	
8.4	Cables	50,000	
8.5	Kerr Rotation HV Monitor	20,000	
9	Measuring Cells		100,000
9.1	Cells	50,000	
9.2	Valves	50,000	
10	SQUIDs		150,000
10.1	SQUIDs	80,000	
10.2	Pick-up Loops	10,000	
10.3	Enclosures	10,000	
10.4	DR Insert	50,000	
11	Light System		110,000
11.1	Fiber Optics or Guides	10,000	
11.2	Cryogenic Feedthroughs	50,000	
11.3	Photomultiplier Tubes	50,000	
12	Electronics / Computers		110,000
12.1	Electronics	75,000	
12.2	Cables	10,000	
12.3	Computers	25,000	
13	Conventional Construction		940,000
13.1	Platforms	100,000	
13.2	Electrical Plant	200,000	
13.3	Plumbing	300,000	
13.4	Mechanical Supports	300,000	
13.5	Jib Crane	25,000	
13.6	Isolation Platform	15,000	
14	Management and Engineering		1,290,000
14.1	Project Manager	190,000	
14.4	Engineering During Construction	500,000	
14.5	Technicians During Construction	600,000	
15	Integration and Commisioning		100,000
15.1	Integration	50,000	
15.2	Commissioning	50,000	
16	Institutional Costs		5,248,000
16.2	40% Contingency During Construction	2,334,000	
16.3	23.5% Burden During Construction	1,920,000	
16.4	Escalation	994,000	
	Totals	11,083,000	11,083,000

C. Schedule Summary

In order to begin construction in FY'05, we anticipate having the project successfully pass a CDR and a technical, cost and schedule review. These reviews should be scheduled consistent with the needs of the funding agencies. Our expectation is that a year or so will pass between submission of the proposal and the reviews, and that many refinements will have been made to the apparatus as well as many new measurements will have been made that further support the feasibility of the experiment.

The EDM project has established 13 top-level milestones to mark progress toward an apparatus capable of making the EDM measurement. These milestones will be monitored to keep the project on schedule. The top-level milestones are

WBS	Milestone	Finish Date
1	EDM Development Complete	9/30/04
5.4	^3He Atomic Beam Source Ready	2/27/06
3.4	Shielding Ready	3/27/06
7.6	Magnets Ready	5/24/06
9.4	Measuring Cells Ready	5/24/06
11.4	Light Systems Ready	5/24/06
6.3	Magnetic Shield Ready	7/23/06
8.6	High Voltage Ready	9/21/06
10.4	SQUIDs Ready	9/21/06
13.5	Conventional Construction Ready	9/21/06
2.7	Beam Line Ready	9/27/06
4.8	Cryogenics Ready	3/20/07
15.3	First Data	1/14/08

Most of these milestones occur in 2006 because this time is when the subsystems are completed and ready for integration into the full detector. The time coincidence is due to the significant amount of work that can be done in parallel. More details can be seen in the project charts in Appendix B. This schedule is heavily dependent on the funding profile actually achieved.

The goal of the milestones is to produce a working experiment at the beginning of 2008. The anticipation is that the experiment will be shaken down for a year by accumulating data that are ever closer to the required level of systematic errors. Roughly 6 months of data taking will follow, leading to an initial physics publication bettering the current limit by a factor of roughly 10. At this time, an evaluation will be made to select the best facility to complete the measurements to the 10^{-28} e•cm level.

D. Management Tools

In all respects, the construction, installation, testing, and commissioning of the EDM experiment must follow the LANL quality assurance guidelines. Additionally, all work has to be conducted in accordance with LANL Integrated Safety Management (ISM) and LANL Safe Work Practices. All the work has to satisfy fully LANL ES&H requirements.

The schedule for the construction of the EDM experiment was developed using Microsoft Project software and is based on planning information and milestones submitted by the collaborators. By the time of the technical review, the work package leaders will have reviewed these items. The main constraints on the overall schedule are the running periods of the facility and the final funding profile. The project manager will use Microsoft Project to monitor the progress of the construction project. The input will come from the management team and work package leaders. Variances will be reported to the experiment leadership and the oversight officials.

The progress of the EDM project will be reported to the DOE on a quarterly basis in the form of an EDM Project Quarterly Progress Report. This report will follow the format as set by the Nuclear Physics Division of the Department of Energy. The reports will be compiled and distributed by the project manager.

These reports will contain:

1. A narrative report of accomplishments and problems;
2. A milestone schedule and status reports, and;
3. A cost performance report.

In addition, the project manager will provide monthly progress reports to the LANL management, the executive committee, and the collaboration.

The management team, aided by the collaboration, has the responsibility for the technical decisions regarding R&D, engineering, design, fabrication, assembly, testing and installation of all the components. Technical changes require approval if they impact cost, schedule, or performance at levels exceeding those indicated in the following table:

Change request classification for the EDM project. Guidelines for changes in cost, schedule and/or performance with their respective approval levels.

Class	Change in			Approval
	Cost	Schedule	Performance	
1	Minor, within WBS line item (<\$5k or 1%)	“float”	No impact	Project Manager
2	Within Work Package contingency, (>\$10k or 1%)	< 1 quarter delay of milestone	Change in a part of work package that does not affect work package performance or scope	Above, plus Spokespersons
3	Within overall EDM contingency (>50k or 10%)	> 1 quarter delay of milestone	Change affects work package performance but does not effect EDM performance	Above, plus Executive Committee and NPP Program Manager
4		> 1 quarter delay of major project milestone	Technical scope change, affects project capability	Above, plus DOE

The EDM project manager will monitor the technical progress of the project, evaluating progress against the plan. Whenever technical changes are anticipated or proposed, the project manager will evaluate all ramifications. The project manager will monitor and evaluate schedule, cost, and interrelated construction and technical work variances to assess programmatic impacts. Should a baseline change be required, the project manager will initiate a change action to propose a baseline revision depending on whether the change is technical or cost/schedule related.

The basis for cost control is the baseline cost estimates of the EDM construction project established at WBS level 4 and shown in this document to level 3. Any changes to the cost of a WBS line item at Level 4 or above must follow the approval requirements indicated in the change request table. Cost control at lower WBS levels is the responsibility of the work package leaders, who will report to the project manager on a monthly basis. Using the Microsoft Project software, the project manager will track the costs.

The basis for schedule control is the milestone schedule contained in this document, which represents the best information available to the management team at the time of the technical review. The work package leaders will track and report their work package to WBS level 5 to the project manager, who, using the Microsoft Project software, will track and report down to WBS level 5. The project manager, together with the work package leaders, will update and revise the milestone schedule as needed.

The variance thresholds that would initiate corrective actions are described as follows:

Variance thresholds that will trigger corrective action

	Cost Variance	Schedule Variance
Period	25% & \$20k	25%
FY	15% & \$50k	15%
Cumulative	10% & \$100k	10%

The EDM monthly status report will provide an explanation of the corrective action to be taken to address the problem that is causing the variances. This variance reporting and corrective action approach will provide an early warning of potential problems. Prompt recognition and corrective action at this level will help prevent implementation of the change management actions earlier.

Contingency funds are included in the EDM project estimate to cover uncertainties and risks. The current uncertainties in the scope of the project have led to the assignment of an overall contingency of 40%. The contingencies will be estimated prior to the CDR at the lowest WBS level as follows:

Guidelines used in estimating the contingencies for items in the EDM project budget.

Contingency Formulae for EDM Budget Estimate		
Category	Description	Amount
Catalog	<ul style="list-style-type: none"> Equipment to be purchased through catalog Fixed price contract (with no rework expected) 	5%
Engineered	<ul style="list-style-type: none"> Design complete, fully estimated, before bid award Fixed price contracts (with some rework expected) 	15%
Designed	<ul style="list-style-type: none"> Design complete, not fully estimated, before bid award Fixed price contracts (with significant rework possible) 	25%
Conceptual	Design incomplete, concept clear	50%
	Design incomplete, concept "notional"	>50%

The contingency funds are held in a separate account by the LANL NPP manager. All the EDM work packages that are funded with DOE capital funds shall follow the rules for contingency spending as outlined in the change request classification table. The use of contingency funds will be monitored closely, and the status of these funds will be reported to key project participants so that the project will not be jeopardized by a cost overrun.